Petra A. Vorwig
Senior Legal & Regulatory Counsel

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Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

5 May 2016

Subject: **Notice of Oral Ex Parte Presentation - Use of Spectrum Bands above 24 GHz for Mobile Radio Services, *et al*; GN Docket No. 14-177**

Dear Ms. Dortch,

On May 5, 2016, representatives of SES Americom, Inc. ("SES") met with representatives of the Office of Engineering and Technology ("OET"), the Wireless Technology Bureau ("WTB") and the International Bureau ("IB") to discuss the above-referenced rulemaking proceeding. The SES representatives present at the meeting were: Petra Vorwig, Senior Legal & Regulatory Counsel, Philippe Secher, Senior Manager, Spectrum Management & Development, and Karis Hastings, outside counsel to SES. The FCC representatives participating in the meeting in person or by telephone were: Jose Albuquerque (IB), Simon Banyai (WTB), Stephen Buenzow (WTB), Martin Doczkat (OET), Chip Fleming (IB), Michael Ha (OET), Chris Helzer (WTB), Tim Hilfiger (WTB), Kal Krautkramer (IB), Robert Nelson (IB), Charlie Oliver (WTB), Barbara Pavon (OET), Matt Pearl (WTB), John Schauble (WTB), Catherine Schoeder (WTB), Blaise Scinto (WTB), and Serey Thai (OET).

The discussion focused on three topics. First, the participants discussed how satellites receiving in the 27.5-28.35 GHz ("28 GHz") band could be affected by aggregate interference from multiple Upper Microwave Flexible Use ("UMFU") terrestrial transmitters in that band. SES presented the attached analysis demonstrating the worst case scenario for satellite receiver interference using the characteristics of its SES-15 satellite, which is scheduled to launch in the second quarter of 2017. (See Attachment 1)

Second, SES outlined its proposal to establish a path to co-primary status for 28 GHz earth stations applied for prior to any UMFU service auction and brought into use in accordance with the Commission's rules.

Third, SES reiterated its support for a future licensing mechanism that provides (1) defined areas where UMFU licensees can deploy on a primary basis without fear of interference from future earth stations, (2) defined areas where satellite operators have certainty that they can operate their 28 GHz band gateways in areas that are low priority for UMFU operators, and (3) an intermediate area where the parties can engage in good faith coordination. SES presented the analysis provided in Attachment 2 to demonstrate the worst case separation distances that would be required to ensure

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that mobile terrestrial operations in the 28 GHz band do not experience harmful interference, using characteristics consistent with the earth stations planned for use with SES-15.

Please contact the undersigned if you have any questions.

Respectfully submitted,

/s/ Petra A. Vorwig

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SES Americom, Inc.

Attachments

cc: Jose Albuquerque
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ATTACHMENT 1

Interference from 5G Systems into the SES-15 Satellite in the 27.5-28.35 GHz Band

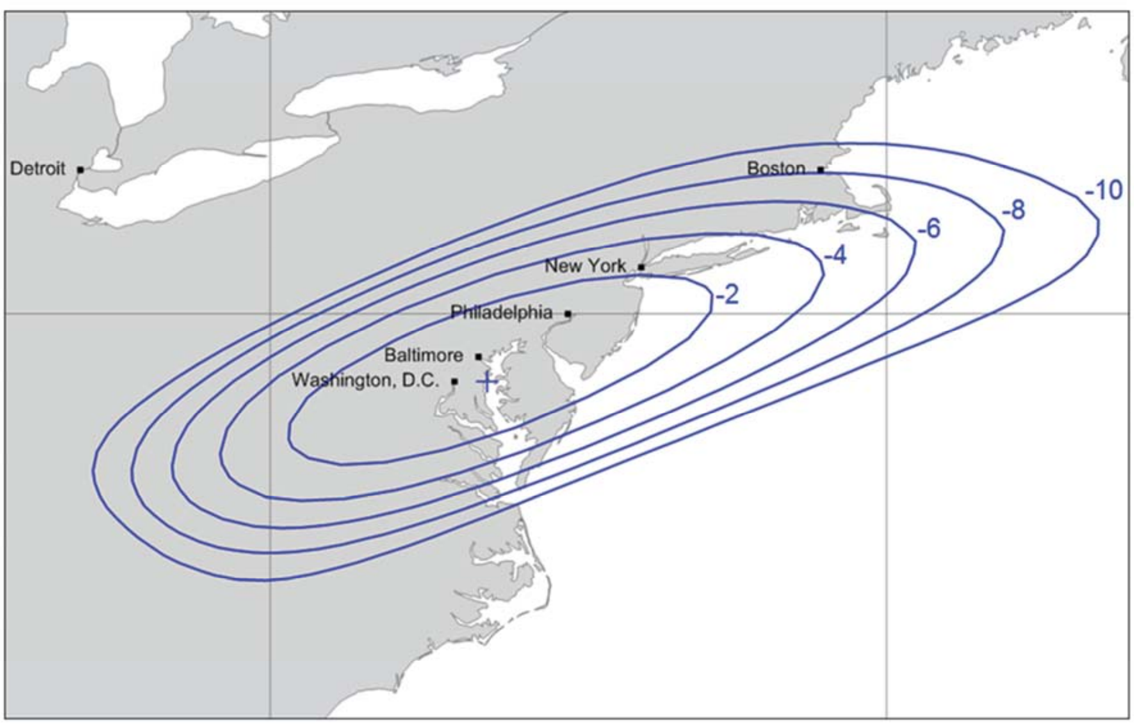
This document analyzes the interference generated by 5G stations into one uplink beam of the SES-15 satellite in the band 27.5-28.35 GHz. This satellite is currently under construction and is scheduled for launch in Q2 2017.

The SES-15 EC Beam

The SES-15 satellite has four beams receiving in the 27.5-28.35 GHz band. Those beams are used by gateway stations which transmit in the entire 27.5-28.35 GHz band to SES-15. The signals are then retransmitted by the satellite to end user terminals through multiple spot beams operating in the Ku-band.

The figure below shows the peak and relative gain contours of the SES-15 EC beam receiving in the 27.5-28.35 GHz band.

Figure 1 - SES-15 EC beam



This beam covers major cities on the East Coast (Washington D.C., Baltimore, Philadelphia, New York, Boston) where deployment of future 5G systems is expected to be significant.

Acceptable Level of Interference into the SES-15 EC Beam

In order to assess the impact of 5G systems into the SES-15 EC beam, the acceptable level of interference is computed as follows:

Item	Parameter	Value	Unit	Comment
1	Total system noise temperature	1047	K	SES-15 specification
2	Thermal noise density at receiver	-168.4	dBm/Hz	10*log(1.3807*10^-23*[1])+30
3	Protection criteria for other co-primary services	-12.2	dB	ITU-R Rec S.1432-1
4	Acceptable interference at receiver per Hz	-180.6	dBm/Hz	[2]+[3]
5	Acceptable interference at receiver per MHz	-120.6	dBm/MHz	[4]+60
6	Satellite antenna gain	51	dBi	SES-15 specification
7	Polarization advantage	3	dB	Circular to linear losses
8	Atmospheric absorption	1	dB	Atmospheric absorption
9	Free space losses	213.3	dB	Free space losses for EC beam peak
10	Acceptable interference radiated from the ground	45.7	dBm/MHz	[5]-[6]+[7]+[8]+[9]

The acceptable aggregate interference radiated towards the SES-15 satellite by all 5G stations located within the SES-15 EC beam is 45.7 dBm/MHz.

Impact of 5G Base Stations

The following characteristics for a 5G base station were considered.

Parameter	Value	Unit	Comment
Maximum EIRP	62	dBm	As per NPRM
Average EIRP	60	dBm	Assumed
Channel bandwidth	100	MHz	As per NPRM
EIRP density	40	dBm/MHz	
Antenna discrimination towards satellite	20	dB	Assumed
EIRP density towards SES-15	20	dBm/MHz	

In order to assess how many 5G base stations could be deployed in the five main cities located inside the SES-15 EC beam before reaching the acceptable aggregate interference level, the acceptable aggregate interference was apportioned among the five cities, taking into account the advantage of the reduced beam sensitivity for the cities located away from the beam peak. It was considered that all 5G base stations were in line of sight of SES-15 and therefore no clutter loss was taken into account. The number of 5G base stations that could be deployed in each city was then computed.

Item	Parameter	Baltimore	Washington DC	Philadelphia	New York	Boston	Unit	Comment
1	Apportioned aggregate interference per city	38.7	38.7	38.7	38.7	38.7	dBm/MHz	45.7 - 10*log(5)
2	EC beam gain contour advantage	0	0	1	2	8	dB	Figure 1
3	Acceptable aggregate interference per city	38.7	38.7	39.7	40.7	46.7	dBm/MHz	[1]+[2]
4	Interference for one 5G base station	20	20	20	20	20	dBm/MHz	As calculated above
5	Number of 5G base stations per city	74	74	93	117	468		10^(([3]-[4])/10)

This analysis shows that the total acceptable aggregate interference radiated towards the SES-15 satellite will be reached when the following numbers of 5G base stations transmitting simultaneously in the same 100 MHz channel and in line of sight of SES-15 have been deployed:

- Baltimore: 74
- Washington D.C.: 74
- Philadelphia: 93
- New York : 117
- Boston: 468

A similar analysis performed considering 5G base stations with a maximum EIRP of 75 dBm[1] leads to the following results:

- Baltimore: 4
- Washington D.C.: 4
- Philadelphia: 5
- New York : 6
- Boston: 23

[1] *See* Notice of Ex Parte filed by Verizon, Samsung Electronics America, QUALCOMM Incorporated, Intel Corporation, Nokia, and Ericsson Inc., filed in GN Docket 14-177 (filed April 21, 2016) (recommending increased power limits for base stations and semi-stationary, movable 5G devices).

Impact of 5G User Terminals

The following characteristics for 5G user terminals were considered.

Parameter	Value	Unit	Comment
Maximum EIRP	43	dBm	As per NPRM
Average EIRP	41	dBm	Assumed
Channel bandwidth	100	MHz	As per NPRM
EIRP density	21	dBm/MHz	
Antenna discrimination towards satellite	10	dB	Assumed
EIRP density towards SES-15	11	dBm/MHz	

Using the methodology explained above for the 5G base stations, the analysis shows that the acceptable aggregate interference radiated towards the SES-15 satellite will be reached when the following numbers of 5G user terminals transmitting simultaneously in the same 100 MHz channel and in line of sight of SES-15 have been deployed:

- Baltimore: 589
- Washington D.C.: 589
- Philadelphia: 741
- New York : 933
- Boston: 3715

A similar analysis performed considering the semi-stationary, movable devices proposed by 5G terrestrial operators with a maximum EIRP of 55 dBm[2] and an average EIRP of 53 dBm leads to the following results:

- Baltimore: 37
- Washington D.C.: 37
- Philadelphia: 47
- New York : 59
- Boston: 234

[2] *See id*.

ATTACHMENT 2

Interference from SES-15 Earth Stations into 5G Systems in the 27.5-28.35 GHz Band

This document analyzes the interference generated by SES-15 earth stations into 5G systems to be deployed in the 27.5-28.35 GHz band.

SES-15 Earth Stations

The SES-15 satellite has four beams receiving in the 27.5-28.35 GHz band. Those beams are used by gateway stations which transmit to SES-15 in the entire 27.5-28.35 GHz band. The signals are then retransmitted by the satellite to end user terminals through multiple spot beams operating in the Ku-band.

For the purpose of this analysis three earth stations located in Brewster, WA; South Mountain, CA; and Woodbine, MD are considered. The assumed characteristics of the earth stations, including the EIRP density radiated towards the horizon, are provided in the following table.

Table 1

	Brewster, WA	South Mountain, CA	Woodbine, MD
Antenna size (m)	9 m	9 m	13 m
Elevation (deg)	34.07	48.7	20.35
Antenna gain (dBi)	66.4	66.4	69.6
Input power density (dBW/MHz)	-13.4	-13.4	-19.6
Off-axis gain (dBi) from §25.209	-6.3	-10.0	-0.7
EIRP density towards the horizon (dBW/MHz)	-19.7	-23.4	-20.3
EIRP density towards the horizon (dBm/MHz)	10.3	6.6	9.7

Acceptable Level of Interference into 5G Systems

In order to assess the impact of the SES-15 transmissions into 5G systems, the acceptable level of interference is computed as follows:

Table 2

Item	Parameter	Value	Comment
1	Interference protection level (dBuV/m)	47.0	Edge of cell limit from NPRM
2	Interference protection level (dBm/m2/5.5 MHz)	-68.8	Conversion from dBuV to dBm/m2
3	Interference protection level (dBm/m2/MHz)	-76.2	Conversion to 1 MHz

The interference protection level for 5G systems is -76.2 dBm/m2/MHz.

Impact of SES-15 Earth Stations into 5G Systems

The distance required between the edge of the nearest interfered with 5G cell and the SES-15 earth stations is computed in the following table using the above interference protection level and assuming a 20 dB clutter loss in addition to the free space loss.

		Brewster, WA	South Mountain, CA	Woodbine, MD	Comment
1	EIRP density towards the horizon (dBm/MHz)	10.3	6.6	9.7	From table 1
2	Interference protection level (dBm/m2/MHz)	-76.2	-76.2	-76.2	From table 2
3	Clutter loss (dB)	20	20	20	Assumed
4	Separation distance (m)	596	390	556	$\sqrt{\frac{[10^{\frac{[1]}{10}}}{10^{\frac{[2]}{10}} * 4 * \pi * 10^{\frac{[3]}{10}}}}$

The distance required to ensure compatible operations between the earth stations described above and 5G systems is:

- Brewster, WA: 596 m
- South Mountain, CA: 390 m
- Woodbine, MD: 556 m

Assuming a more stringent protection criteria of 10 dB (-86.2 dBm/m2/MHz), the distances are:

- Brewster, WA: 1884 m
- South Mountain, CA: 1232 m
- Woodbine, MD: 1757 m